

## Documentation of Original Ice Chart Data Set

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## 1.0 General Description

This file contains information on file names, file structure, and ice cover codes given in Assel et al (2002) and Norton et al (2000). The reader is referred to these publications for more information. If these data are used in publications or presentations, Assel et al (2002) and Norton et al (2000) should be cited as its sources.

R.A. Assel, D.C. Norton, and K.C. Cronk, 2002. A Great Lakes Digital Ice Cover Data Base for Winters 1973-2000. NOAA TM ERL-GLERL-121, Great Lakes Environmental Research Laboratory, Ann Arbor, MI. [ftp://ftp.glerl.noaa.gov/publications/tech\\_reports/glerl-121/](ftp://ftp.glerl.noaa.gov/publications/tech_reports/glerl-121/)

D.C. Norton, R.A. Assel, D. Meyers, B.A. Hibner, N. Morse, P.J. Trimble, K. Cronk, and M. Rubens. 2000. Great Lakes Ice Cover Data Rescue Project. NOAA TM ERL-GLERL-117, Great Lakes Environmental Research Laboratory, Ann Arbor, MI. [ftp://ftp.glerl.noaa.gov/publications/tech\\_reports/glerl-117/](ftp://ftp.glerl.noaa.gov/publications/tech_reports/glerl-117/)

A total of 1122 ice charts are available in ARC/INFO export format and as formatted ASCII Grids. These data are arranged by winter season in subdirectories 1973 through 2000. Each subdirectory contains the following types of files:

1. Graphic files of total ice concentration
2. ARC/INFO export files in Zip compression
3. ASCII Grid files in Zip compression

In addition, the ASCII Grids for the Period of Record (POR) can be downloaded in 14 Zip compression files, one file for each of the 14 ice attributes described below.

## 2.0 File Names The names of each file type encodes the data of the file.

### 2.1 Example of ARC/INFO Export Coverage File Name: g20000228u.e00, where:

1. g = originating from GLERL
2. 2000 = year
3. 02 = month
4. 28 = day
5. u = NIC\* source [ a 'c' indicates a CIS\*\*]
6. .e00\*\*\* = ARC/INFO export coverage

\* NIC = National Ice Center; \*\*CIS = Canadian Ice Service

\*\*\* A ".txt" extension is used for ice attribute files, such as g20000228u.txt for this coverage.

### 2.2 Example of ASCII Grid File Name: g19941230c.ct\*, where:

1. g = originating from GLERL
2. 1994 = year
3. 12 = month (Dec.)
4. 30 = day
5. c = CIS source
6. .ct = ice attribute\*\* of total ice concentration (% of surface area covered by ice).

\* The December 30, 1994 ice chart is part of the 1995 winter season so it is located in subdirectory 1995.

\*\* There are 14 ice attribute grids for this source and date. Descriptions of their extensions are as follows:

1. .id the polygon identification numbers
2. .ct the total ice concentration (% of surface area covered by ice)
3. .ca the percentage concentration of the thickest ice type
4. .cb the percentage concentration of the 2nd thickest ice type
5. .cc the percentage concentration of the 3rd thickest ice type
6. .so the thickest ice present, assigned 5% concentration
7. .sa the thickness of ca
8. .sb the thickness of cb
9. .sc the thickness of cc
10. .sd the thinness ice present, normally > 10%
11. .fa the floe size of ca
12. .fb the floe size of cb
13. .fc the floe size of cc
14. ~ the percentage of ice concentration of strip & patch

### 2.3 Examples of Total Ice Concentration Graphic File Names and Periods Used

c73apr06.jpg, c = CIS, 73 = 1973, apr = April, 06 = day, for winters: 1973 – 1995.

u88dec14.jpg, u = NIC, 88 = 1988, dec = December, 14 = day, for winters: 1989 – 1996.

gl00feb29.jpg, gl = Great Lakes\*, 00 = 2000, feb = February, 29 = day, for winters: 1997 – 2000.

\* the source of these files can be either NIC or CIS.

**3.0 ASCII Grid File Description** The coverages are in a Mercator projection. ASCII Grids were generated from raster polygon ID files of the ARC/INFO coverages. The ID grid files were adjusted to match a master grid in order to obtain consistent water and land cells. The ID grid was then used with an attribute file (example: g20000228u.txt) to generate the other 13 ice attribute grids using FORTRAN software.

**3.1 File Structure** There are 510 data records preceded by 6 header records in each grid. The header records are shown below. Each row of data after the 6 headers has 516 grid cells in a fixed I3 format. Land and island cells have a code of -1.

	Record		Explanation
1	ncols	516	Number of columns of data matrix
2	nrows	510	Number of rows of data matrix
3	xllcorner	-649446.25	Longitude of lower left corner cell in meters
4	yllcorner	3306260	Latitude of lower left corner cell in meters
5	cellsize	2550	Nominal cell size (m), actual size varies with latitude
6	NODATA	value -99	Code for no data

### **3.2 Conversion of ASCII Grids to ARC/INFO Raster Files**

Some users may prefer to use these standardized grids in the ARC/INFO environment. Software to do this (reformat.f, asciarc.aml) is given in the appendix of Assel et al 2000. Reformat.f is also available as an executable image (i.e. compiled and ready to execute on a PC) in the POR subdirectory. Information on converting the ASCII Grids is given in Assel et al (2002).

**4.0 ARC/INFO File Description** A medium resolution vector base map of the Canadian and U.S. Great Lakes and St. Lawrence River shoreline was used as a base template when digitizing ice polygons from historic ice charts. (Details are given in Norton et al, 2000). Ice attribute data were encoded and linked to the polygons. Ice attribute codes are an integer form of the World Meteorological Organization (WMO) "egg code". Each ice polygon has a set of 13 possible attributes and a polygon identification number (ID) assigned to it. Land areas and islands in the lake are assigned a value of zero for all polygon attributes. Not all attributes are present for any given ice polygon. Each ice polygon has a single record, describing the ice attributes for **Ice Concentration, Ice Stage of Development and Form of Lake Ice** in the following order: ID, Ct, Ca, Cb, Cc, Sa, Sb, Sc, Fa, Fb, Fc, So, Sd, ~

#### 4.1 Ice Attribute Codes

**ID** is a 3-digit integer identifier of a polygon

##### Ice Concentration

- 1 **Ct** is the total ice concentration as a percent (when present, it includes the percentage of **So** or **Sd**)
- 2 **Ca** is the percentage concentration of the thickest ice type
- 3 **Cb** is the percentage concentration of the 2nd thickest ice type
- 4 **Cc** is the percentage concentration of the 3rd thickest ice type

##### Ice Stage of Development

- 5 **So** is the thickest ice present, assigned 5% concentration
- 6 **Sa** is the thickness of Ca
- 7 **Sb** is the thickness of Cb
- 8 **Sc** is the thickness of Cc
- 9 **Sd** is the thinnest ice present, normally > 10%

##### Form of Lake Ice

- 10 **Fa** is the floe size of Ca
- 11 **Fb** is the floe size of Cb
- 12 **Fc** is the floe size of Cc
- 13 ~ is the percentage concentration of strip & patch

**5.0 Ice Cover Codes** There are three types of ice attributes, ice concentration (percent of unit of surface area covered by ice), ice age (thickness class), and ice form (floe size). The codes for each of these ice attribute types is given below and contained in ARC/INFO and ASCII Grid files.

**5.1 Ice Concentration** Ice concentration (Ct, Ca, Cb, Cc, and ~) have units of percent ice cover which range from 0 to 100 in increments of 5; code -88 is a placeholder (i.e. no data) and code -99 is missing data.

**5.2 Stage of Development Codes** Stages of development (So, Sa, Sb, Sc, Sd) are listed using codes in decreasing order of thickness. The following codes are used to denote stage of development (range of ice thickness) of lake ice:

Code	Description	Ice Thickness Range (in cm)
0	no stage of development	00 (no ice)
1	new ice	00 to 5
4	thin lake ice	5 to 15
5	medium lake ice	15 to 30
7	thick lake ice	30 to 70
8	1 <sup>st</sup> stage thick ice	30 to 50
9	2 <sup>nd</sup> stage thick ice	50 to 70
10	very thick lake ice	70 to 120
-8	place holder	
-9	missing data	

**5.3 Ice Form Codes** Forms of lake ice (Fa, Fb, Fc) indicate sizes corresponding to the stages identified in Sa, Sb, and Sc respectively. Codes 0, 1, and 2 refer to the shape of the individual pieces of ice. Codes 3, 4, 5, and 6 refer to the sizes of the ice floes. Code 8 refers to ice that forms and remains attached to the shore.

The following codes are used to denote forms of lake ice:

Code	Description of Ice Form
0	pancake ice (30 cm – 3 m)
1	small ice cake (<3m) or brash ice (<2m)
2	ice cake (3m – 20m)
3	small floe (20m – 100m)
4	medium floe (100m – 500m)
5	big floe (500m – 2km)
6	vast floe (2km – 10 km)
8	fast ice
-8	place holder
-9	missing data

## 6.0 ZIP Compression Files

These files were originally created and compressed on a Windows platform. Please be aware that formatting errors may occur if uncompressed using a non-Windows platform.